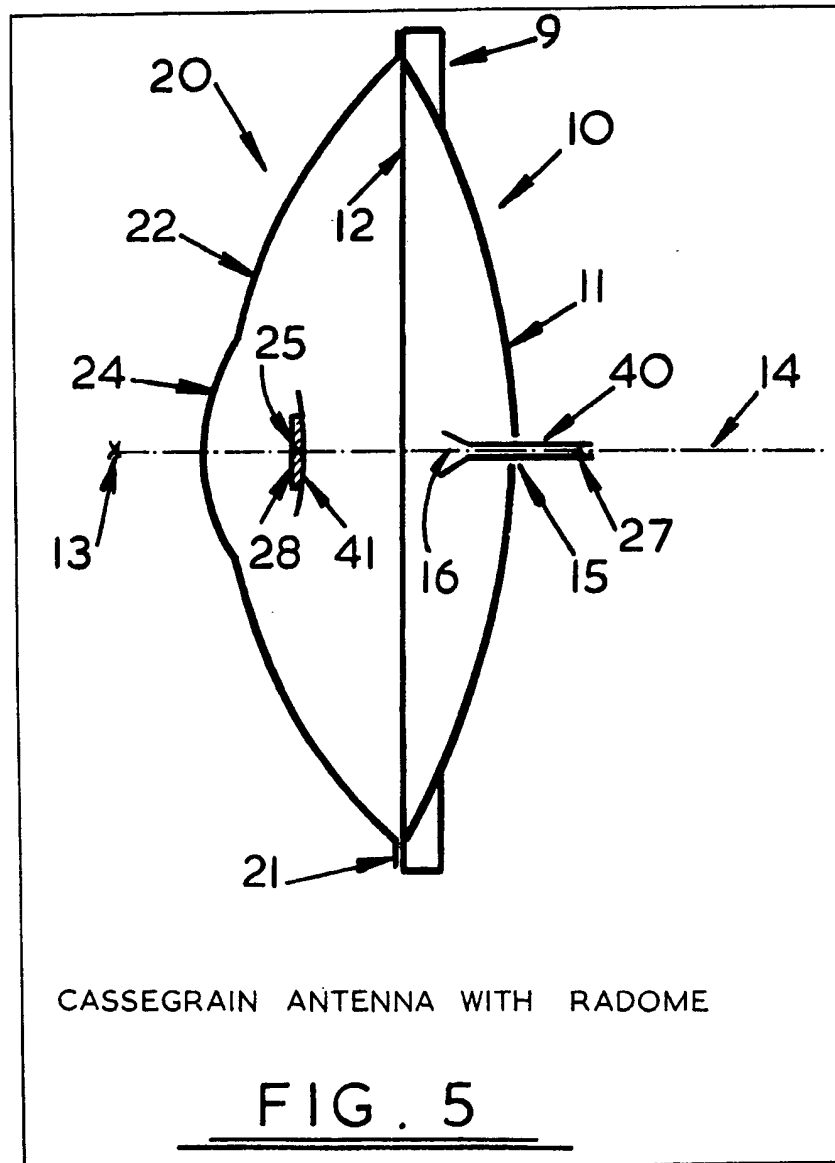


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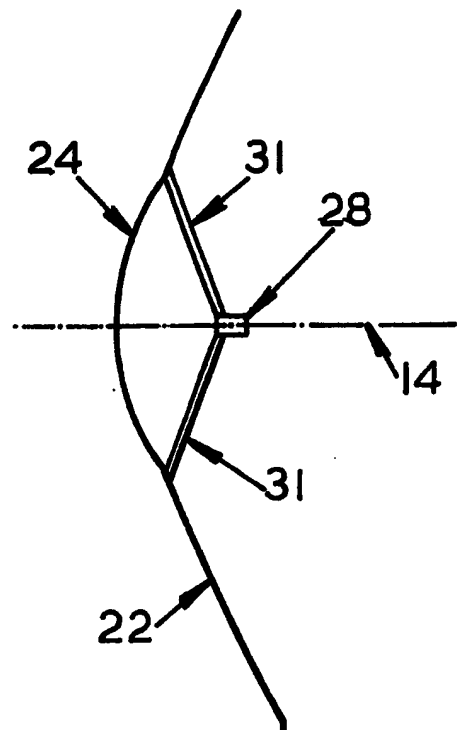
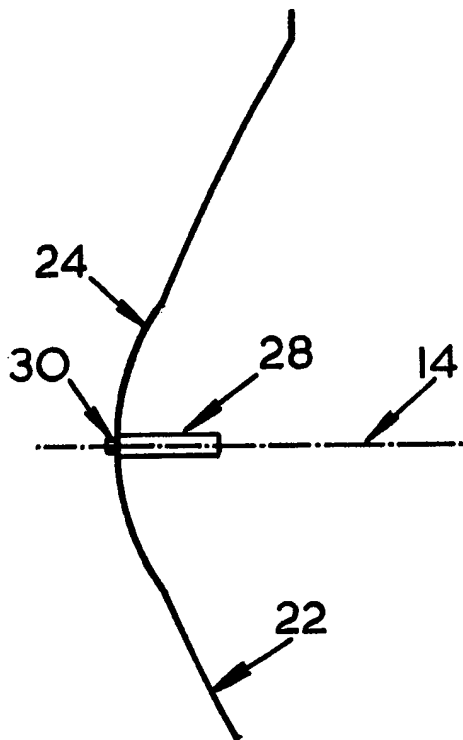
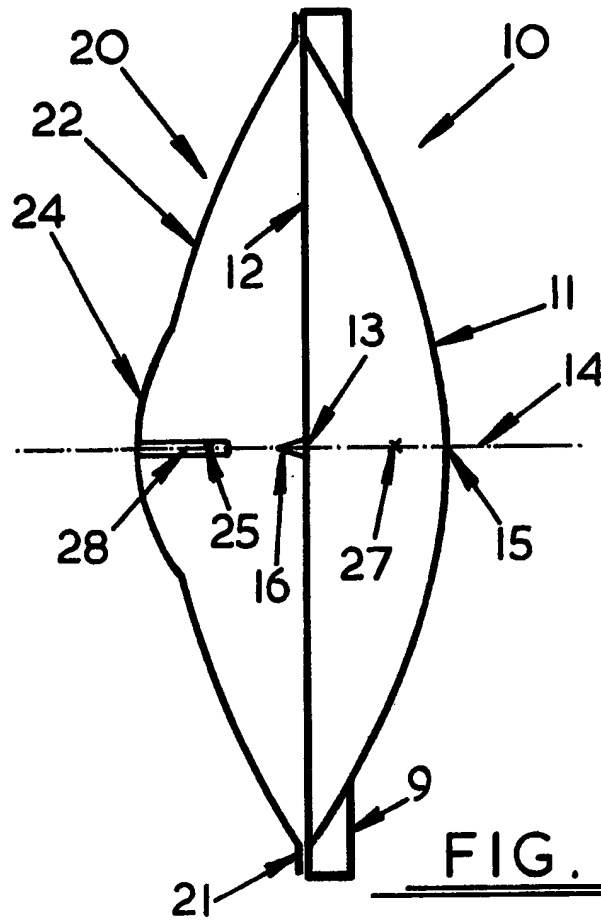
(54) Radome-covered reflector antennas

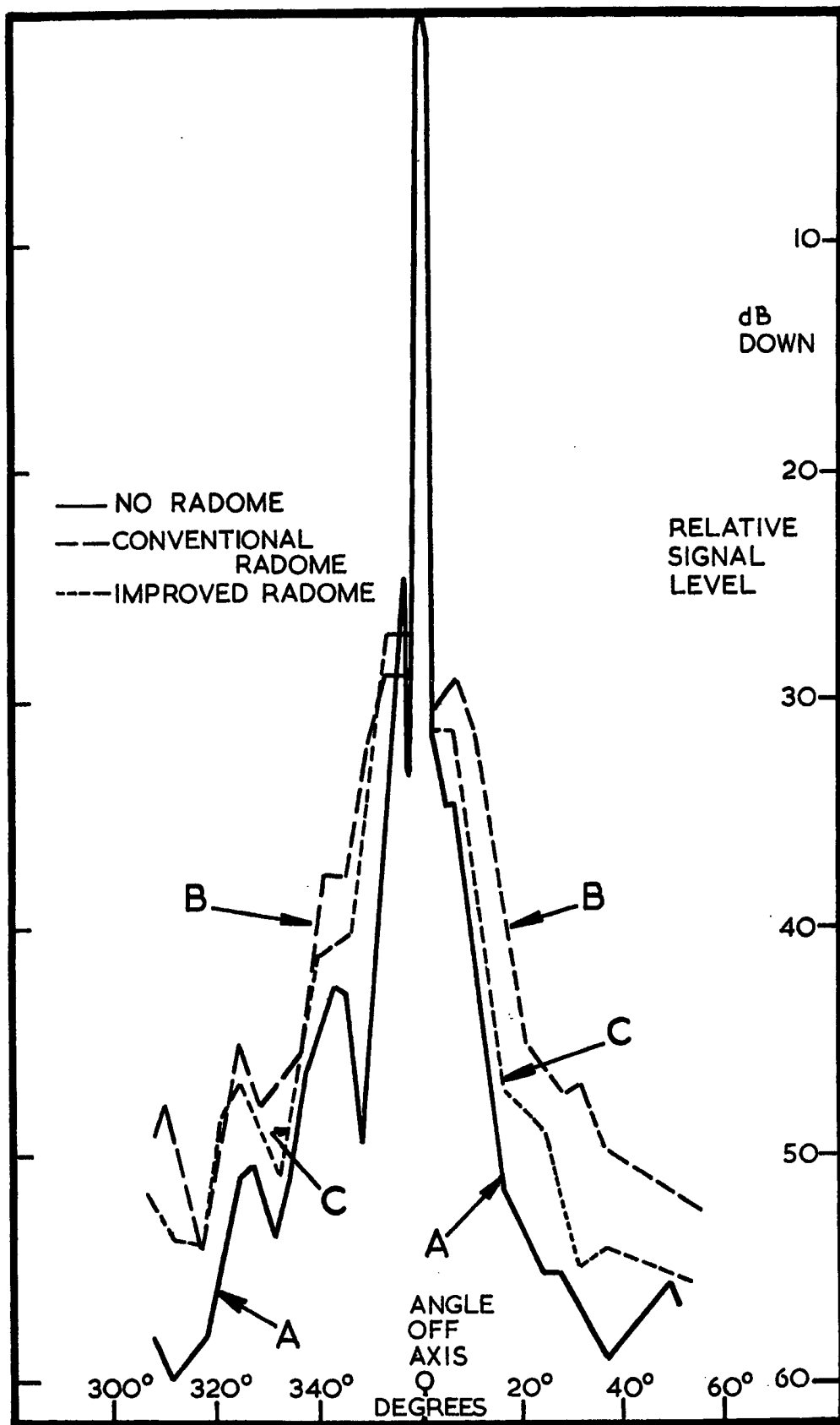
(57) An antenna assembly (10) comprises a paraboloidal reflector (11) having a microwave signal feed assembly (40) including a feeder (16). A radome (20) secured to the reflector (11) comprises a first paraboloidal portion (22) of annular configuration surrounding a second paraboloidal portion (24), portion (24) being of shorter focal length

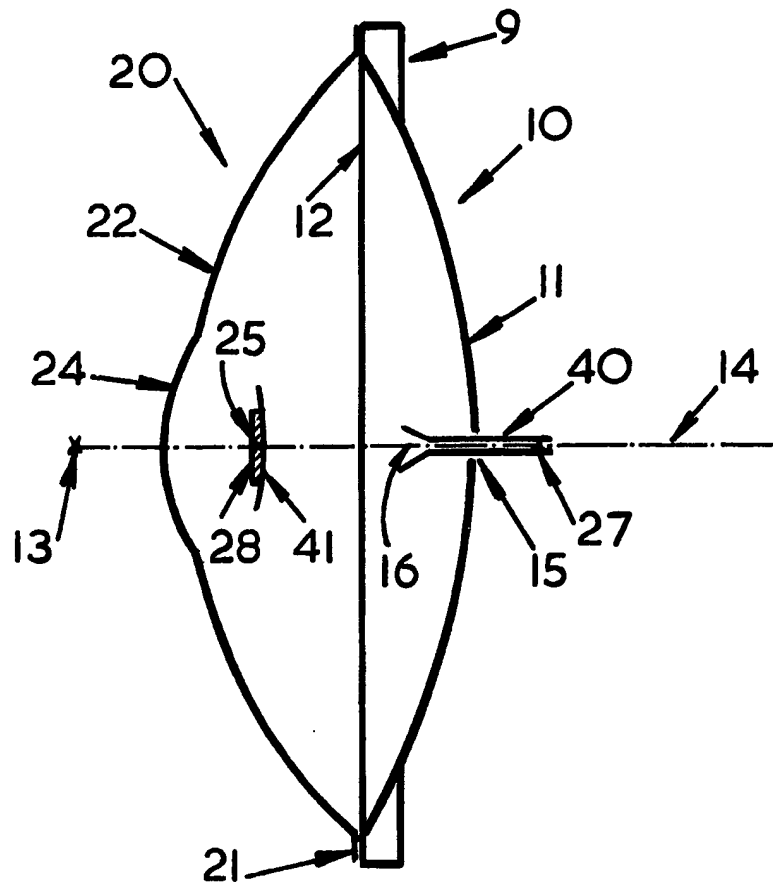
than portion (22) such that the focus (25) of portion (24) is no nearer the reflector (11) than the feeder (16). The focus (27) of portion (22) is also non-coincident with feeder (16) and a body (28) of radiation absorbing material is located at focus (25) to absorb reflected radiation from portion (24). Body (28) may be mounted on the radome (20) or on the assembly (40). As shown the arrangement comprises a Cassegrain antenna with a convex reflector 41. Other arrangements are envisaged.



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FIG. 4



CASSEGRAIN ANTENNA WITH RADOME

FIG. 5

SPECIFICATION

Radome-covered reflector antennas

5 This invention relates to radome-covered reflector antennas.

Reflector antennas are used extensively in microwave communication systems and comprise a paraboloidal reflector adjacent the focus of which is located the microwave signal feed assembly. The feed assembly in one common form comprises a feeder formed at the end of a waveguide which penetrates the reflector at its vertex and is secured thereto, the waveguide portion between the feeder and the reflector vertex being curved or otherwise shaped so that radiation emergent from the feeder is directed towards the reflector.

Such known forms of reflector antennas are susceptible to performance degradation due to dirt adhering to the reflective surface of the reflector and/or due to wind loading on the antenna and to mitigate these problems it has become standard practise to fit a weather cover or radome to the antenna. In its simplest form the radome may be a sheet of reinforced fabric such as Terylene (Registered Trade Mark) which provides a substantially planar weather cover but in order to reduce wind loading the weather cover requires curvature and accordingly many radomes now in use are of simple paraboloidal form, being made of fibreglass. Unfortunately the presence of the radome, but particularly the known simple paraboloidal form, introduces unwanted radiation reflections so that the radiation pattern of the antenna per se is distributed and radiation reflected back into the feeder may also have a damaging effect on the signal supplying equipment.

It is an object of the present invention to provide an improved form of radome-covered reflector antenna and more particularly to provide an improved form of radome for use with a reflector antenna.

According to the present invention there is provided a radome-covered reflector antenna comprising a paraboloidal reflector having a microwave signal feed assembly including a feeder, the assembly being arranged so that emergent radiation appears to emanate from the focus of the reflector, and a paraboloidal radome secured to the reflector, wherein said radome has first and second paraboloidal portions of differing focal lengths, said first portion being of annular configuration and surrounding said second portion and said first and second portions each being concave with respect to said reflector, the focal length of said second portion being less than that of said first portion and such that the focus of said second portion is not near the reflector than said feed assembly and the focal length of said first portion being such that the focus of said first portion is non-coincident with said feed, and a radiation absorbing material is located at the focus of said second portion.

Conveniently the antenna is of the focal plane type, i.e. where the perimeter of the reflector lies in the plane through the focus of the reflector normal to

the principal axis of the parabola, but this need not be the case so that the reflector perimeter may lie in a plane parallel to the focal plane and intersecting the principal axis either between the focus and the vertex of the parabola or beyond the focus.

The focus of said first portion of the radome may lie between the feeder and the vertex of the reflector or it may lie on the side of the plane containing the reflector vertex and normal to the axis of the parabola remote from the feeder.

The signal feed assembly may comprise a waveguide which penetrates the paraboloidal reflector at its vertex and is secured thereto and which extends in a curved path to terminate at an aperture, referred to herein as the 'feeder', from which the microwave signal is emitted, the aperture or feeder being at or near the focus of the reflector and the feeder being directed towards the reflector. Alternatively the signal feed assembly may comprise a radiant energy reflector (hereinafter referred to as a 'sub-reflector') located adjacent the focus of the paraboloidal reflector and onto which radiant energy is beamed from a waveguide terminating in a feeder at or near the vertex of the paraboloidal reflector. This form of signal feed assembly may be either the Cassegrainian or the Gregorian type. As is known the Cassegrainian type has a curved sub-reflector presenting a convex reflector surface to incident radiation and the sub-reflector is located so that the virtual focus from which the reflected radiation emanates is at or near the focus of the paraboloidal reflector. It will therefore be evident that in Cassegrainian arrangement the sub-reflector is located between the vertex and focus of the paraboloidal reflector. In the Gregorian arrangement the sub-reflector presents a concave reflector surface to incident radiation and is located so that the real focus established thereby is at or near the focus of the paraboloidal reflector. It will therefore be evident that in the Gregorian arrangement the sub-reflector is located between the focus of the paraboloidal reflector and the radome.

The radiation absorbing material may be affixed to the radome or to the signal feed assembly and for example may be made of foamed plastics. Conveniently the radome is made of fibreglass of the order of 2-3mm in thickness in order to withstand wind loading at about 125 mph and the reflector is made of aluminium. The radome may however be of sandwich section if so desired but in this case its radiation transmitting performance would be frequency dependent.

The present invention also provides a radome having the characteristics described for retrofit to an existing reflector antenna.

It will be understood that by virtue of the present invention unwanted radiation reflections at the radome are substantially prevented from degrading the performance of the reflector antenna whilst the entire assembly is protected against weather conditions and the wind loading factor is reduced. Accordingly an improved emitted radiation pattern is achieved together with improved impedance matching of the antenna to the feeder waveguide.

Embodiments of the present invention will now be described by way of example with reference to the

accompanying drawings, in which:

Figure 1 diagrammatically illustrates a first embodiment of radome-covered reflector antenna according to the present invention;

5 *Figures 2 and 3* illustrate alternative arrangements of a detail of the first embodiment;

Figure 4 illustrates comparative performance characteristics; and

Figure 5 illustrates a second embodiment.

10 As is illustrated in *Figure 1* an antenna assembly 10 comprises a paraboloidal reflector 11 of the focal plane type, i.e. the perimeter 12 of the reflector 11 lies in a plane containing the focus 13 of the paraboloid the principal axis of which is denoted 14 and the vertex of which is at 15. Structurally the reflector 11 is provided with a perimetrical ring 9 for stiffening purposes and also to facilitate mounting of the reflector 11 on a support structure (not shown). A microwave signal feeder 16 is shown at the focus 13 and orientated to direct emitted radiation towards the reflector 11, the feeder 16 being provided by a copper waveguide which is not illustrated in the interests of clarity.

The radome 20 of the assembly 10 is also paraboloid in form and is secured at its perimeter 21 to the perimeter 12 of the reflector 11. Radome 20 comprises a first paraboloidal portion 22 which is of annular configuration surrounding a second paraboloidal portion 24. Portion 24 has a relatively short focal length such that its focus 25 is no nearer the reflector 11 than the feeder 16 and in the assembly illustrated the focus 25 is substantially spaced from feeder 16. Portion 22 has a focal length substantially greater than that of portion 24 and its focus 27 is non-coincident with feeder 16 and as illustrated lies between feeder 16 and vertex 15. A body 28 of radiation absorbing material is located at the focus 25 so as to absorb reflected radiation from portion 24, it being this central zone of the radome 20 which gives rise to the most serious unwanted reflections in known radomes. The radial extent of portion 24 (as measured from axis 14) is preferably about one third of that of the entire radome 20, as illustrated. It will be evident that this value can readily be increased or decreased in order to increase or decrease (respectively) the amount of reflected radiation absorbed but the consequential decrease or increase in portion 22 causes an increase or decrease (respectively) of wind load factor and accordingly a compromise is required.

Figure 2 illustrates the body 28 of absorbing material in the form of a column attached to a spigot 30 secured to portion 24 of the radome 20. Figure 3 illustrates the body 28 in the form of a cube attached to arms 31 secured to portion 22 of the radome 20.

Figure 4 illustrates the performance characteristics of a reflector antenna with a radome, curve A, against the same reflector antenna with a conventional radome (i.e. a paraboloidal radome generated from a single parabola) curve B, against the same reflector antenna with a radome in accordance with the present invention, curve C. It will be evident that curve C is closer to curve A than curve B at practically all off-axis angles.

65 In the embodiment illustrated in *Figure 5* the

reflector antenna assembly 10 is of the Cassegrainian type so that the signal-delivering waveguide 40 penetrates the paraboloidal reflector 10 at its vertex 15 and terminates in an aperture or feeder 16 directed away from reflector 11. A convex reflector 41 is provided to reflect radiation from feeder 16 onto reflector 11 from a virtual focus coincident with focus 13. It will be observed that focus 13 lies outside the assembly 10, this feature of compactness being typical of the Cassegrainian arrangement. Radome 20 has its portion 22 of relatively long focal length so that its focus 27 is non-coincident with feeder 16 and portion 24 of radome 20 has its focus 25 behind reflector 41, the body 28 of radiation absorbing material being mounted on the rear of the reflector 41.

Although the Gregorian form of reflector antenna assembly is not illustrated it will be evident that its physical structure is similar to that shown in *Figure 5* except that reflector 41 is concave. However in this case focus 13 requires to be located between reflector 41 and reflector 11 and non-coincident with feeder 16 since the radiation focus is real. The body 28 can be located on the rear of reflector 41 as described in relation to *Figure 5*.

CLAIMS

1. A radome-covered reflector antenna comprising a paraboloidal reflector having a microwave signal feed assembly including a feeder, the assembly being arranged so that emergent radiation appears to emanate from the focus of the reflector, and a paraboloidal radome secured to the reflector, wherein said radome has first and second paraboloidal portions of differing focal lengths, said first portion being of annular configuration and surrounding said second portion and said first and second portions each being concave with respect to said reflector, the focal length of said second portion being less than that of said first portion and such that the focus of said second portion is not nearer the reflector than said feed assembly and the focal length of said first portion being such that the focus of said first portion is non-coincident with said feeder, and a radiation absorbing material is located at the focus of said second portion.

2. An antenna as claimed in claim 1, wherein said radiation absorbing material is carried by the radome.

3. An antenna as claimed in claim 1, wherein said radiation absorbing material is carried by the microwave signal feed assembly.

4. An antenna as claimed in any preceding claim, wherein the radial extent of said second portion of the radome is one-third of that of the entire radome.

5. A radome-covered reflector antenna substantially as hereinbefore described with reference to either of the embodiments illustrated in the drawings.